agriculture

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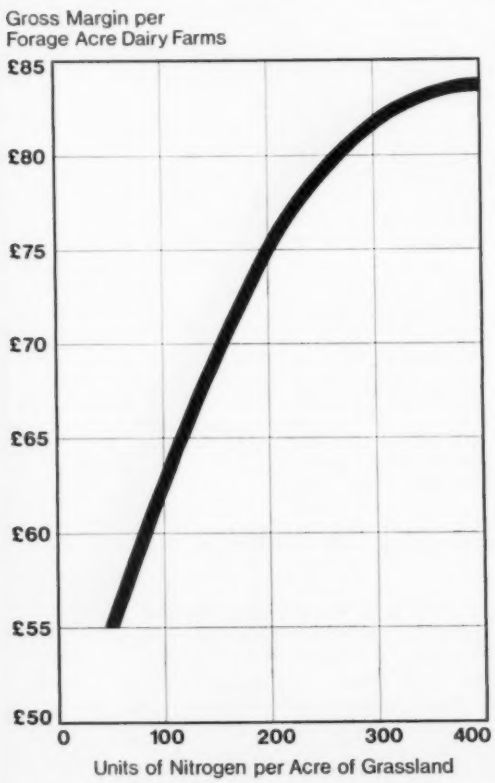

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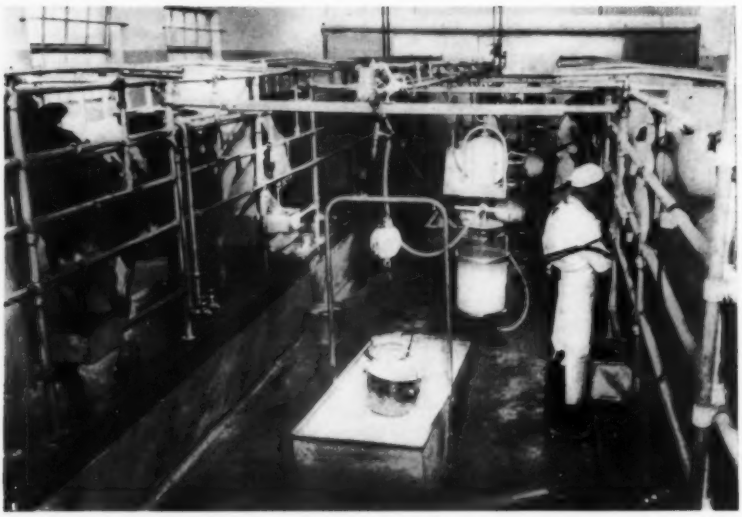


Tandem milking parlour

Milk Production Costs Scheme

W. Harwood Long

THE publication of 'Costs and efficiency in milk production, 1968/69'* provides a convenient opportunity for reviewing the progress of what is frequently referred to as the milk costs scheme. This is an investigation conducted by the university economists in co-operation with the Ministry of Agriculture, Fisheries and Food and the Milk Marketing Board: on it any attempts to improve the organization of dairy farming must rely for much of their data.

This article traces the history of the scheme as revealed by the changes in the methodology employed in operating it. It also outlines the financial and structural changes which have occurred in dairy farming during the life of the investigation. Finally it draws attention to some of the features of the latest report.

*Costs and Efficiency in Milk Production. Obtainable from H.M. Stationery Office.
1955-57 (*out of print*) 1960-61 (*out of print*)
1965-66; 29p (34½p by post) 1968-69; 52½p (58p by post)

History of the scheme

The milk costs scheme was conceived by a committee set up in 1934 in which the bodies mentioned above were represented along with the Agricultural Economics Research Institute, Oxford. Under its provisions, information on the costs of milk production, collected on a provincial basis from producers, was centrally co-ordinated.

Its objects are diverse and the emphasis placed on each has varied during the scheme's existence. The main aims have been: to provide a basis for local investigations and advisory work amongst farmers, and for research into the the economics of milk production; and for price fixing policies.

The earlier history of the scheme is exceptionally well documented in a work by Dr. Phyllis Manning†. Thereafter its progress can be followed in the series of reports on 'Costs and efficiency in milk production' which follow each of the costings periods*.

Minor changes in method occurred almost every year, but in 1952 a major change took place. Up to that time the scheme had been devised for the purpose of collecting costings material, and annual reports were published. By 1952 it was considered advisable to break the continuity of the costings investigation so that time and resources might be temporarily transferred to local research projects. For nearly twenty years now the periods of formal costings have alternated with two- or three-year periods for research.‡

The work of collecting the costings material has been undertaken by the university economists.§ There were good reasons for choosing them for the job. They were situated on the spot; they were acquainted with local farming conditions; for much of the period they were responsible for providing advice to farmers on management problems; and their academic integrity has never been challenged.

The scheme covers the whole of England and Wales and all the provinces have participated. Initially it was intended that the work load should be divided equally between them but this object was never achieved and in 1945 it was agreed that the number of farmers co-operating with a centre should bear some relationship to the importance of dairy farming in the province. Beyond this the economists were free to use their own judgment in selecting the sample from *bona fide* producers. Inevitably this led to an element of bias which reduced the value of the scheme so far as it depended on statistical accuracy. In particular, there was a tendency for the owners of the larger herds and the producers of graded milk to join it. Moreover the amount of recording required prevented many typical producers from wishing to participate. On the other hand, a random selected sample of the size which individual provinces could deal with would have been of much less value for advisory work even if a satisfactory proportion of the selected farmers had agreed to co-operate.

The original purpose was to cost milk production as a single farm enterprise: no attempt was made to look at the place of the milking herd in the

†A History of the National Investigation into the Economics of Milk Production 1934-1951. 1960 Agricultural Economics Research Institute, Oxford.

‡This research is summarized in Aspects of Dairy Economics 1952-55 *(out of print)*
H.M. Stationery Office " " " " 1957-60 27½p (by post 33p)
" " " " 1962-65 30p (by post 34½p)
" " " " 1966-69 50p (by post 55½p)

§Until 1945 four of the economists were attached to agricultural colleges.

economy of the farm as a whole. Indeed, it was not until 1955 that followers were costed, and then only experimentally.

The farmers who co-operated were required to fill in and send to the provincial centre each week a detailed costing sheet. Other data were collected periodically from them by the survey method. Primary returns were sent from the centres to the Ministry and the material was then written up annually. For the first ten years the reports were prepared by the Agricultural Economics Research Institute. Since then responsibility for them has been undertaken by the Ministry. In addition, the provincial centres use the data relating to their own provinces for local purposes. During the 1934–1952 period the number of milk producers co-operating at any one time varied between 500 and 700—about half of one per cent of the number of herds in England and Wales.

Most of the weaknesses which led to the changes in method already referred to were not vital, but a few posed problems. One of the more difficult of these had to do with the cost of herd replacement; another affected the costing of home grown foods apart from grazing, which has always been entered at its individual farm cost.

An important change in method dates from the 1965/66 period when sampling was done for the first time on the basis of random selection. To facilitate the changeover, the amount of information collected was reduced from what had been required previously and regular recording was no longer insisted on. Nevertheless, the fact that two farmers out of every three invited to co-operate agreed to do so says a lot for the importance that farmers attach to this work.

The changed basis of sampling encouraged a more sophisticated approach to the analysis of the material: the latest report contains a section devoted to regression analysis of the 1965/66 and 1968/69 costs.

These examples illustrate some of the developments in thinking on the subject of costing over a period of nearly forty years. In a nutshell, the scheme has changed course to the extent that instead of being based on the carefully kept records of a selected sample of milk producers it now relies on material collected largely by the survey method from a representative cross section of dairy farmers, and considerable time is now spent on local research.

Financial and structural changes in production

The revisions that have taken place in the costings scheme during its existence and the changes in the value of money are a warning of the care needed in comparing different periods. Nevertheless, many of the comparisons that are available through the reports are so striking that they deserve mention.

During the first eighteen years there was not much change in the structure of dairy farming as revealed by the costs apart from the smaller share taken by herd replacement. But the later reports show that some important developments have taken place. For instance, the average size of a herd in the scheme has increased in spite of the effect which random sampling has had in bringing in a larger proportion of small herds. There are also changes in housing and in methods of milking. Although by 1968/69 60 per cent of the herds were still housed in cow sheds, considerable progress was being made in the introduction of kennels and cubicles. Moreover, the proportion of herds using a pipeline to convey the milk to a churn or tank increased, though this was partly because most of the producers who gave up milk production had been using bucket units.

Some comparisons of costs are significant, too. Gross costs per cow rose continuously between 1951/52 and 1970/71 (projected); but, although foodstuffs represented at least half of the total throughout the period, the most striking increase was in miscellaneous costs, which include servicing and maintaining capital equipment. Much of the increase under this heading reflects the success farmers have had in installing labour saving devices, for during the same period the time spent on labour per cow was reduced from 142 hours to 73 hours. However, unit costs of labour nearly trebled between 1950/51 and 1968/69 while prices of milk rose by only one-fifth, and the margin between costs and returns fell. In fact the cash family income was preserved only by an increase in the proportion of the dairy work undertaken by the farmer and his family.

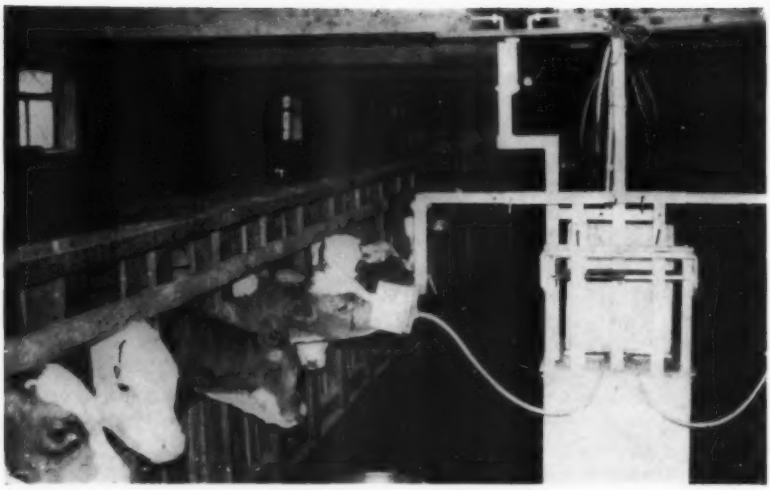
'Costs and efficiency in milk production 1968/69'

This book is the fourth in the series. Nearly 80 per cent of the 426 producers who provided information had costs which were lower than the average gross return per gallon. (This is almost the same as saying that this proportion made a profit, after charging up unpaid labour). With the help of a supplementary questionnaire a projection was made for 1969/70 and 1970/71. It showed that in those years profits should have been maintained at their previous levels.

However, there were wide variations in individual profits and the report attempts in more detail than its predecessors to establish the principles on which profitable management is based. In this, its successes are limited and the authors admit that it is easier to state the problems than to solve them. This will not surprise any student of farm management who will find, nevertheless, that the analysis of the data justifies the exercise because of the information it reveals on the trends in dairy farming and the number of standards it provides for successful management. The reduction in the hours of labour during the last twenty years is an example of this. Similarly, those producers who grew forage crops (including grass) cheaply had big advantages over those who relied more on concentrates. These were frequently fed unnecessarily. The success of the former was usually associated with the use of nitrogen, for on average every £1 spent on nitrogen increased margins by £2·7. When this resulted in heavier stocking it must have been particularly rewarding, for the margin over feed costs was twice as high per forage acre when the stocking was under 1½ acres per cow as when it was over 2¼ acres. On the other hand, the depressing effect of a high proportion of dry cows is reflected in the milk yield, for each additional one per cent of dry cows reduced the average yield of the herd by 8-9 gallons per cow.

There is so much information of a like nature in this publication that few readers can fail to spend their time profitably amongst its pages.

W. Harwood Long, M.A.(Oxon), Dip. in Rural Economy (Oxon) now retired was formerly Head of Agricultural Economics Dept. of Leeds University and also Chairman of the Milk Costs Committee.



Automatic feeders in operation

Veal Calf Housing in The Netherlands

W. A. Thompson

MODERN quality veal production is a highly intensive system. The present methods of production and housing have been largely developed in the Netherlands, where in the early '50s the economic situation forced small farmers to intensify. A large quantity of veal—about one-seventh of total European requirement—is still produced there but its production is now equalled by West Germany and Italy with approximately one million head each, by France with four million head and by Belgium and Luxembourg with a quarter of a million head. British production is currently about 50,000 head.

There are at the present time about 5,000 veal producers in the Netherlands compared with about 7,800 three to four years ago. This reduction has been brought about largely by the high price of calves forcing the less efficient producer out of business. The units remaining in production are increasing in size, and specialist units vary from 400 to 1,400 calves. On average, they have between 250 and 400 calves per man, in exceptional cases up to 500 per man.

Environment

Such a highly intensive industry must be well equipped with good buildings, the design of which is soundly based upon the results of research into optimum

climatic conditions. This work has been carried out mainly at the Insititute for Agricultural Research into Biochemical Products and the Institute for Farm Buildings Research at Wageningen and by commercial firms engaged in the production of milk powder.

The optimum temperature range lies between 15°C and 21°C, but a reduction in the temperature to 10°C will not adversely affect the older, heavier calf. A rise in temperature much above 26°C, particularly if associated with a reduction in relative humidity, is likely to affect weight gain adversely by reducing appetite.

Relative humidity appears to be extremely important. There are indications that when it is very high, above 85 per cent, weight gain increases and food conversion improves, but that there is a high risk of scouring which, to some extent, may diminish otherwise beneficial effects. One further objection to high relative humidity is the likely adverse effect on the structural life of the building; but with good design and constructional methods and the proper use of modern materials these risks can be largely overcome. The conclusion reached is that relative humidity should preferably be within the range 65-75 per cent and under 50 per cent avoided.

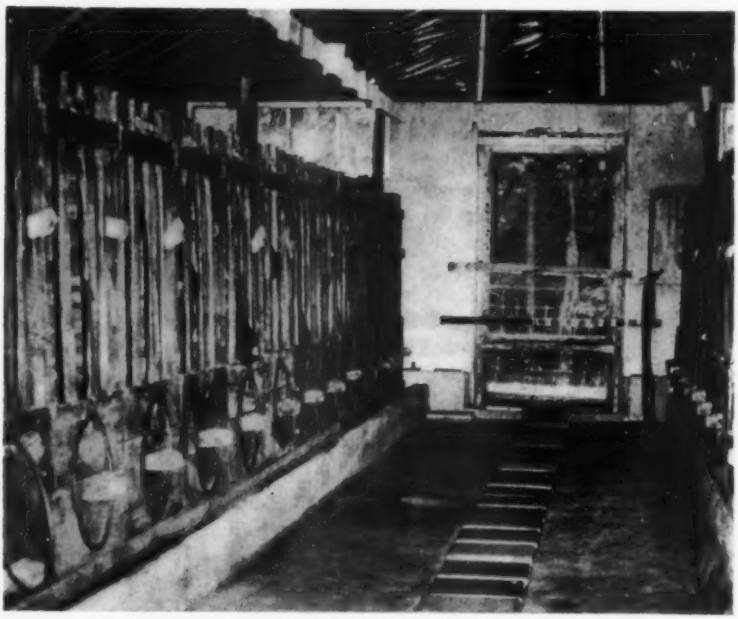
The range of ventilation rates advocated in Dutch practice are a minimum of 10 m^3/hr/50 kg calf (equivalent to 0·05 cfm/lb liveweight) and a maximum of 150 m^3/hr/150 kg calf (0·28 cfm/lb liveweight). These are somewhat lower than the rates advocated in this country of 0·10 cfm/lb minimum and 0·25-0·50 cfm/lb maximum. The Dutch climate differs from ours in that it has a continental as opposed to a maritime influence, being colder and drier in winter. As a consequence, low rates of ventilation can be tolerated without correspondingly large rise in relative humidity. The maximum summer ventilation rate of 150 m^3/hr/150 kg is below recommended United Kingdom rates for a similar latitude and other ways of reducing the temperature are employed. For example, hosing down the floors is common, and in one or two cases sprinkler systems spray water over the roof. This latter method, it is said, will reduce the internal temperature by as much as 5°C.

Environmental control

Great emphasis is placed upon the installation of heating equipment in order to maintain the relatively high internal temperatures necessary. Many of the older Dutch houses are equipped with what one would regard as full domestic central heating with hot water piped to wall mounted radiators. However, this type of system is expensive to install and calls for careful siting of air inlets to ensure that incoming air passes over radiators and is therefore warmed before it reaches the calf; otherwise cold draughts and uneven temperature distribution could result.

The most recent houses overcome this problem by introducing fresh air into a common access passage which acts as a plenum chamber in which the air is pre-heated before it is drawn through the various calf compartments leading off the main passage. Thus the background temperature of the air can be maintained at about 15°C and any topping up necessary according to the age of the calves can be done within the compartment by means of secondary heating. Natural gas is the most common form of heating in the Netherlands, burnt either in a heat exchanger or by means of flueless radiant burners. The fact that flueless burners liberate relatively large quantities of moisture into

the atmosphere is of no consequence when trying to maintain fairly high relative humidity.



Underfloor air inlet ducts with concrete kerbs preventing draughts under slatted floors

Insulation of the buildings to reduce heat loss and keep down heating costs is essential. Standards of insulation advocated in the Netherlands are higher than in this country, partly due to the lower temperatures experienced in winter but also because of the need for a high measure of control over internal climate in this type of house. Roof or ceiling insulation is commonly 60-80 mm (2·4-3·2 in.) of expanded polystyrene or glass fibre and wall insulation rather less, 40-50 mm (1·6-2 in.). The use of expanded polyurethene is not so widespread as it is here and a slightly reduced thickness is acceptable due to its higher insulation value. Vapour barriers to prevent condensation within the insulation are most essential, particularly in veal houses where high internal relative humidities are maintained. Alternatively, insulation material having a high vapour resistance should be used.

Stocking density in terms of the cubic air space per animal is not as high as it may appear at first sight. 7 m^3 (250 cu.ft) per calf is regarded as the ideal density and most calf houses work out close to this figure. Mechanical ventilation is almost universal, automatically controlled in the majority of new houses by solid state equipment similar to that in this country. Various methods of air distribution are employed, including fan extraction at ridge level with inlets in the side walls, or side wall extraction with underfloor duct inlets in the central feed passage.

However, the system which appears to be the most satisfactory and used in most of the more recent buildings is a through flow from end to end of the

calf compartment. In this system, an extractor fan is situated in the outside wall at the end of the feed passage of each compartment to draw air through the compartment from the main access passage. The main airflow is down the feeding passage between two rows of calves; as the calves are confined in crates all facing in towards the feeding passage, this ensures that they all receive a sufficient supply of fresh air. There appear to be no distribution problems with this system.

Construction

Planning control in the Netherlands is administered by central government and there are no exemptions for farm buildings. The general standard of construction and appearance of most agricultural buildings, at least in the centre of the country, is very high. The most common form of construction employed on veal houses is traditional cavity wall with brick outerskin, 50 mm (2 in.) cavity and 100-150 mm (4-6 in.) innerskin of foamed concrete insulation blocks, rendered and sometimes painted internally. In some cases the cavities are filled with urea formaldehyde foamed *in situ* or similar cavity filling for additional insulation. Roof construction is mostly timber covered with corrugated asbestos sheets or pantiles and with insulation fixed to the underside of the purlins or rafters on the roof slope.

Package deal timber buildings of the type common here are not so prevalent in the Netherlands although a small number of the most recent buildings are of this type. They are typically well constructed and finished and are particularly attractive in appearance. Floor construction is of concrete usually about 100 mm (4 in.) thick on a damp-proof membrane and uninsulated.

Prefabricated package deal building

The feed passage is level and there is a 1 in 13 fall under the crate to the dung channel at the rear of the crate and a narrow back-walk between the dung channel and the wall. The fall on the dung channel is 1 in 200. The

moisture content of the dung is extremely high, the calves being on an all liquid diet. Hosing down the floor under the crates further adds to the moisture content and no difficulties are experienced with drainage flow.

There was a time when it was thought necessary to keep veal calves in the dark in order to produce the typically white meat, but it has now been proved that this is not so and Dutch regulations prescribe a minimum window area of 1/70th of the floor area.

Penning

Veal calves are confined in hardwood crates or boxes which measure 1·50 m (5 ft) long × 0·60 m (2 ft) wide and 1·10 m (3 ft 8 in.) high at the front and 1·05 m (3 ft 6 in.) high at the rear. The crates have solid divisions and are arranged in rows facing a central feed passage. Fifty calves in a compartment is advocated as the maximum number. The front of the crate, which is removable for getting calves in and out, is fitted with a yoke and bucket holder except where feeding is automatic, and the rear is closed by 25 mm (1 in.) diameter tubular steel rails. The floor is slatted with 75 mm (3 in.) × 25 mm (1 in.) slats with 25 mm (1 in.) gaps, and is removable for cleaning.

Feeding systems

Automatic and semi-automatic feeding systems are most common on large units. The automatic system consists of a machine on a monorail which passes down the feeding passage stopping opposite each pair of calves in turn for a pre-determined period. Milk is supplied to the machine from a central food mixing room by a flexible pipeline and the calf takes milk from a teat mounted on the machine.

Feeding buckets mounted on a revolving rail shown in 'out of use' position

Feeding is usually four times a day with this method and the advantages are that a greater number of calves per man can be managed and a more natural rate of intake of milk achieved. The disadvantages, however, are a greater risk of disease transfer by way of the teat and no quick and easy guide, such as milk left in a bucket, to indicate to the stockman when a calf is unwell.

The semi-automatic pipeline system consists of a fixed pipeline usually running along the main access passage with take-off points at the entrance to each compartment. The operator is equipped with a long length of hose and a dispenser nozzle similar to that used for filling petrol. The hose is clipped into the take-off point and each calf bucket is then filled in turn, the yoke opened and the calf allowed to drink. The method is extremely quick, a compartment of fifty calves being fed in less than ten minutes. The great advantage over the automatic system is that a calf which refuses milk can be spotted easily and there is no risk of cross infection because each calf has its own bucket permanently fixed in front of the yoke.

Clearly there is a great deal to be learnt from the Dutch in the matter of veal calf housing. A visit to the Netherlands, which is occasionally organized by feedingstuffs companies who specialize in the production of veal milk powder, would be well worthwhile for any farmer contemplating such an enterprise. It should, however, be noted that calf pens 600 mm (2 ft) wide as used in the Netherlands would not qualify for grant-aid in the United Kingdom because they do not comply with the welfare code for cattle issued under the Agriculture (Miscellaneous Provisions) Act 1968: this recommends that the width of the pen for a singly-penned animal should not be less than the height of the animal at the shoulder.

W. A. Thompson, A.R.I.C.S., is Farm Buildings Adviser with A.D.A.S., Wolverhampton.

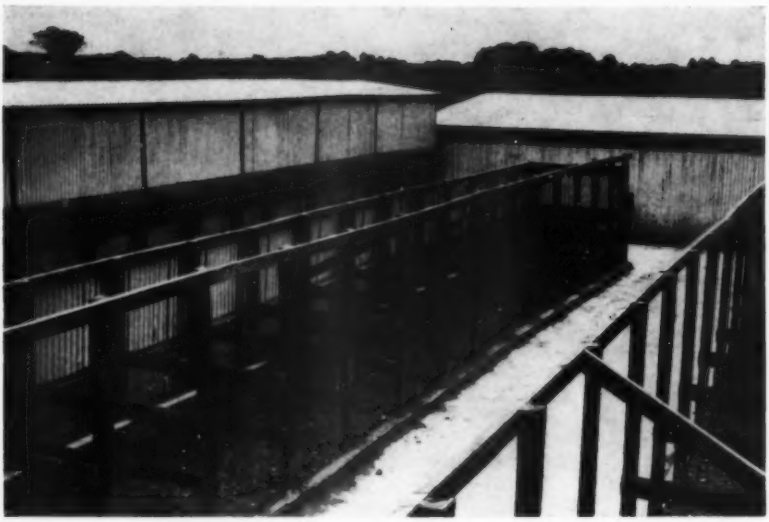
Keep Your Eye on the Bull

A number of people are killed and many others injured on our farms every year in accidents caused by animals. When farmers and farm workers are in daily contact with animals, familiarity can sometimes breed contempt; but all animals are unpredictable and bulls in particular should always be considered potentially dangerous.

Experience clearly shows that a bull that has been placid and tractable for years and has never shown any signs of agression may suddenly turn and attack without warning.

Unless running with the herd, a bull should be housed in a properly-built bull pen. In addition to adequate housing, there are some basic rules which should be observed by all stockmen. Items that the bull can toss about should never be left in the pen. Doors should be secured at all times so that they do not rattle or swing to attract the bull to play with them. The pen area should always be kept clean, so that neither bull nor man is liable to slip. All fixtures and fittings should be in good working order and a sound bull pole should be readily available for immediate use. The bull should be secured from outside before entering the pen. Children and dogs should be kept away from the vicinity of the pen and no one should be allowed to tease the bull. A serviceable spare ring should always be available. When tethering in the field, the tether should be placed in position before the bull is led out and the stockman should never turn his back on the bull until well beyond its reach.

A bull should be handled frequently; it will become nervous and excitable if it is left alone for days on end. A bull pole should always be used when the animal is led. The bull's head should be kept well up and the stockman should walk to one side, slightly behind its head. Bull poles should be properly constructed and maintained and so designed that they can be clipped on without the handler having to close with the animal. A stockman should never try to separate a bull from a herd without assistance.



Topless Cubicles

John Perry, A.R.I.C.S., *Lands Arm, A.D.A.S., Winchester.*

THE ever-increasing cost of labour, the need to improve the working conditions of his stockmen and the damaging effect of poaching by outwintered cattle were some of the main factors that prompted Roy Shepherd of South Allenford Farm, Damerham, Hampshire, to consider inwintering his suckler herd. It was clearly necessary that any housing accommodation provided should be erected at a low cost, and having seen topless cubicles working successfully in Southern Ireland, Mr. Shepherd decided there was little to loose by trying them on his farm for at least part of his 120 cow herd. So last year he erected cubicle accommodation for thirty-six cows with calves at heel. A sheltered site on the south-east side of an existing building was selected, close to one of the most frequently used farm roads on his 1,550 acre holding.

Construction details

Two rows of cubicles were constructed on either side of an 8ft concrete access passage with an adjoining open feed area and a covered calf creep at one end. The whole layout was constructed by farm labour using secondhand timber and new galvanized corrugated iron sheeting at a cost of about £18 per cow and calf, after grant.

The cubicles are 7 ft × 4 ft with the front and ends of each row sheeted in with 6 ft galvanized corrugated iron sheeting. The cubicle divisions comprise two horizontal timber rails with a 7 ft high rear post to enable the layout to be easily roofed over, should this prove necessary. The cubicle beds are formed of gravel dug on the farm topped with straw.

The feeding arrangements for the cows are a timber feeding trough with a bunker fed hay-rack constructed above, both of which can be filled without having to enter the feeding area. Two men normally take about an hour twice a week to fill the bunker.

The calf creep is, in effect, a small open-fronted south-facing building measuring 35 ft × 16 ft × 8-10 ft high, with a 4 ft × 3 ft calf access from the cubicle area at the rear. The ends are clad with space boarding, and a hay-rack and bunker fed manger are provided. Towards the end of the winter, the creep proved to be too small for all the calves and temporary arrangements had to be made to increase the size to provide 20 sq. ft of clear floor area for each calf. Slurry is scraped from the layout three times a week to a nearby holding area: this operation usually takes one man with a rear-mounted tractor scraper about forty-five minutes.

Results

In one winter's use there have been undoubted savings in labour. One man has inspected and fed the group in less than thirty minutes a day, and with the cubicles being sited near to one of the main roads through the farm, he has been able to do it when travelling from one job to another. The in-wintering of the cows and their calves has also made good stockmanship much easier to practise.

Although odd cows have persistently laid in the access passage and feeding area, the majority of the cows have used the cubicles quite readily, although it has been found necessary to keep the cubicles topped up with straw. There were one or two problems with calves using the cubicles, particularly during the milder weather. However, with the enlargement of the creep these problems appear to have been overcome, but in a second layout to be erected this year, the creep will be sited alongside the cubicle area. During bad weather all the calves used the creep.

The cubicle beds kept reasonably clean and drained quickly after heavy rain. The gravel used for the beds contains very little clay and does not, therefore, compact easily. This has probably contributed to a great extent to the free-draining nature of the beds. There have been no problems with the health of the cows and the calves. Calves kept in the layout over the past winter, which has been milder and probably wetter than usual, have shown the same average daily liveweight gain as a similar group outwintered.

One winter's occupation has indicated where the benefits are in accommodating cattle in this form of housing. But it will need to be in use for a few more winters yet before any firm conclusions can be reached and it can be established whether the few pounds per cow saved by not roofing the cubicles is justified.

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The Photograph on page 350 of the August issue of *Agriculture* has unfortunately been printed upside down. We apologize for the error.

Machinery and Labour Co-operation

This feature, on the group operation of machinery and labour, contains articles by:

★ **Warner K. Hall, N.D.A., N.D.A.E.,** a Mechanization Adviser with A.D.A.S. at the Wye Sub-Centre, Ashford, Kent.

Group Operations: Silage Making

Warner K. Hall

WHERE the aim is to produce a high quality forage, grass for silage must be cut at the right stage of maturity to obtain a good level of digestibility. It is advantageous to have a silage-making team which can conserve the maximum amount of grass within the ideal range of digestibility. Many farmers cannot attain this ideal due to the absence of suitable machinery and an adequate labour force. But there are situations on many farms where it may be beneficial to share machinery and labour in order to reduce the capital invested in machinery and to enable an effective labour force to be built up for an enterprise requiring a continuous operation.

Machinery

In the past, most silage has been made by direct cutting using a single chop flail harvester. Many machines have a high power requirement and therefore a restricted output, and the length of chop of material is not ideal for self-feed or easy feeding in the winter. An improved single chop flail harvester, perhaps side mounted can be used; or a double chop machine which produces a shorter material better suited to most feeding systems, can pick up material from the swath and can be used effectively in a wilting programme. A group may also be able to use a metered chop harvester which chops the crop into short lengths by means of a cylinder or fly-wheel chopping mechanism. This type of machine has the advantage of achieving a higher output than the single or double chop; and the short lengths can be handled by buckrake or blower when made and fed mechanically by loader, forage box or mechanical feeder.

Surveys have shown that it is seldom the forage harvester output that limits performance of a silage-making system. It is more often the transport and trailers which prevent the harvester from working at full capacity in the field. Trailers used on farms are usually converted general-purpose 3-ton trailers, often with inadequate sides and limited load capacity. Also, the rear tailgate has to be opened by hand, an operation which can take up to five minutes on arrival at the clamp and so cause an undesirable break in the system. Group operation can justify the use of larger trailers with well designed silage sides and self opening tailgates.

Because high speed silage-making is a flow process it requires continuous operation of machines and therefore a regular force of men. Due to having insufficient men, many farmers have to reduce their system output at such times as milking and are therefore unable to conserve as much grass as is potentially possible in a given time. In a group operation, by pooling men as well as machines it is not necessary to call on other skilled men from their normal work. A gang of men used to operating field machines can then be

organized to operate continuously and so conserve the maximum amount of grass.

Where a programme of harvesting is to be organized it is important to arrange a suitable programme of fertilizer application and choice of grass variety. A group can operate a modern fertilizer distributor and share cultivation equipment for reseeding.

On most dairy farms there is the problem of day-to-day waste disposal, and also of the disposal of solid farmyard manure at the end of the winter. The volume of waste to be disposed of at the end of the winter almost equals that of the silage made in the spring. If group operation is used for making the product it is possible that it can be used also for disposal of the waste product.

Examples of group operation for silage making

The first example illustrates the use of a single chop flail harvester and the second the use of a metered chop harvester, both used in systems of making wilted silage.

Single chop flail harvester

This group comprises three small dairy farmers. Two have made silage in previous years but have obsolete equipment; the third has not made silage before. Figure 1 illustrates the system of making silage when the farmers operated as individuals and when they operated as a group. *Farm A* consists of 100 acres with fifty-seven cows being increased to seventy. Sixty acres are to be cut for silage during the year. *Farm B* comprises 82 acres, with fifty cows being increased to sixty. This farmer has not made silage before and plans to cut 46 acres during the year. *Farm C* has 146 acres and forty-five cows, these being raised to sixty. Silage has been made before and 65 acres are to be cut in the season.

Because of the need to produce a silage of higher quality, the group decides to purchase a flail mower to promote rapid wilting. A side-mounted offset 43 in. flail harvester is chosen as this enables the forage tractor to tow trailers direct on its draw bar with the forager side-mounted on the tractor. Farmer A agrees to provide a medium sized tractor and one man who cuts ahead in the evenings with the flail mower at $1\frac{1}{2}$–2 acres an hour. During the day this tractor tows trailers. Farmer B is to provide a medium sized tractor and one man, and uses the 6 ft buckrake from Farm C. Farmer C's contribution is the provision of a medium sized tractor and one man for the forage harvester to work at 1–$1\frac{1}{2}$ acres per hour. All the trailers are 10 ft $\times$ 6 ft with home-made silage sides; two only are used in the system, those from farms A and C, with the spare trailer from C and the tipping trailer without silage sides from B being kept in reserve in case of breakdown.

Although the acreages to be harvested are not equal it is decided after discussion to apportion all costs equally. By prior agreement each farm is providing one man so there is no need to adjust for this. In most group situations it is important for arrangements to be made to allow for adjustments in respect of labour and machinery charges and a simple record sheet can be devised to enable these costs to be balanced out at the end of the season. A rota is fixed between members with cutting starting on Farm B in the first year, then on C and finally on A. This rota will change every year,

with adjustment in a difficult season. If the farms had continued to make silage on their own, Farms A and C would have had to purchase new harvesters; and Farm B, because it was changing from hay to silage, would have required a harvester, a trailer and a buckrake. The following Table summarizes the annual machine costs for group and single operation for all the farms:

	Farm A	Farm B	Farm C
	£	£	£
Cost when operating on own	139	240	139
Cost when operating in group	92	92	92
Savings	47	148	47

When set up, this group agrees to follow the guidelines for successful group operation (as discussed in the article 'Group Operation of Machinery and Labour' published in the August 1972 issue of *Agriculture*) which have been followed successfully with few problems.

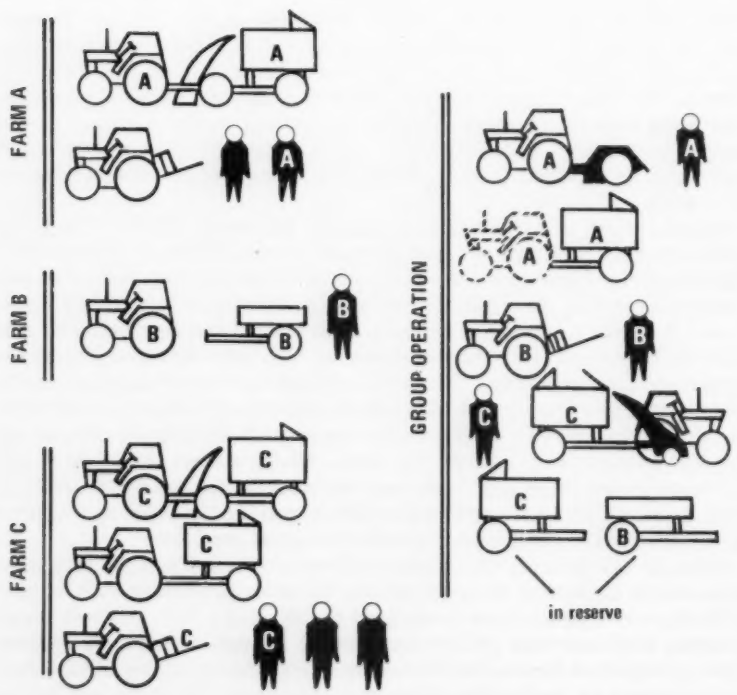

Fig.1

Metered chop harvester

Three farmers with livestock enterprises, two dairy and one beef and sheep, are faced with the problem of not being able to produce sufficient silage of good quality. The season was extended due to the need to take labour from each farm team at milking time. *Farm D* consists of 400 acres arable and dairy, with 125 dairy cows, followers, beef and sheep; 700 tons of silage (140 acres cut) are to be made each year. *Farm E* has 220 acres, all dairy, with 120 cows, and 600 tons of silage (120 acres cut) are to be made annually. *Farm F*, of 310 acres, has beef and sheep and arable crops, and requires to make 200 tons silage (40 acres cut) each year. Figure 2 illustrates the systems of making silage before and after group formation.

With a total of 2,000 tons of silage to be made on the three farms, it is decided by group discussion to purchase a full chop forage harvester in order to achieve maximum output, and to couple this with two tandem-wheel trailers with self-opening tailgates. A drum mower is also bought for pre-cutting to improve quality. This is a technique no farm had used before. A push-off buckrake is needed to fill silos at a rate which keeps pace with loading in from the forager.

A full chop forage harvester

Farmer F owns a large tractor which is used to drive the harvester. Tractors are available on each farm to carry out the transport, mowing ahead and buckraking. The six 10 ft × 6 ft trailers are retained on the farms in reserve and used on long hauls when required. The cutting programme is determined following a crop inspection and the expected date of maximum digestibility. Farmers D and E organized the work on their own farms but each operates the forager on the other's farm. This resolves the problem of

deciding which tractor driver operates the forager. The head tractor driver on each farm is responsible for his own farm's buckraking. For cutting and transport, tractors are drawn from whichever farm has them available; 6-10 acres are cut ahead with the drum mower and single swaths are picked up and loaded into trailers at 1½-2 acres an hour. One man shuttles trailers and one loads the clamp. A 4-man team is required for the whole operation.

Farmers D and E sold their forage harvesters in part exchange for the new equipment. The use of the large tractor from Farm F is exchanged for labour and tractors used from the other farms when operating on Farm F. The cost of the new equipment is divided according to the tonnage of silage produced in the following proportions:

Farm D 3/7 Farm E 3/7 Farm F 1/7

Because Farm D has a greater tonnage and uses more labour and machines than Farm E, records are kept of labour use and adjustments made if required. Tractors are filled with fuel before leaving each farm.

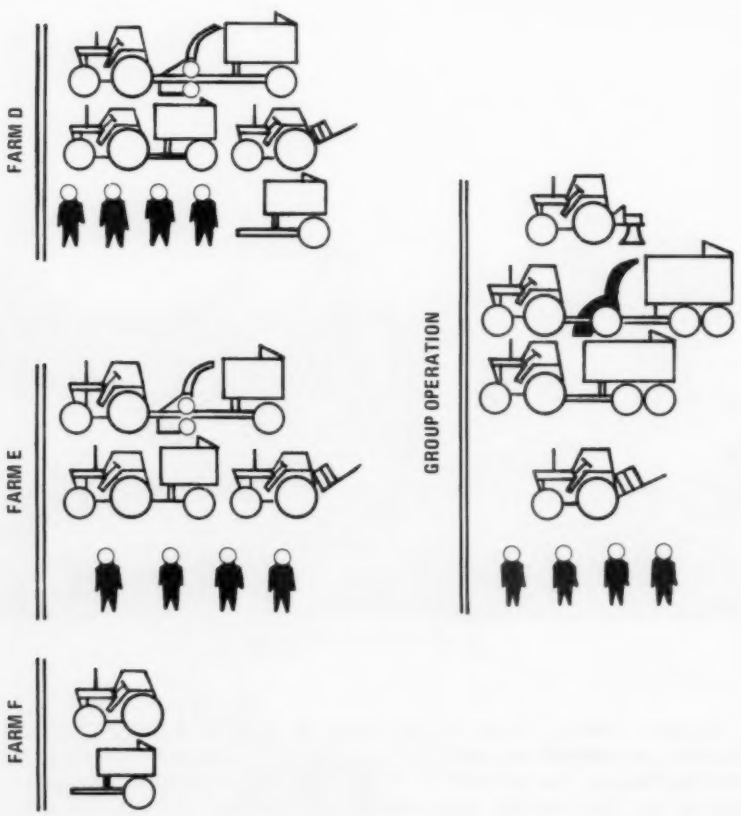

Fig 2

The annual charge to the group for machines is £945 and this is apportioned on the same basis as the cost of new equipment, hence the machine costs are:

Farm D £405 Farm E £405 Farm F £135

This is the charge which has to be offset by higher quality forage and more effective use of labour. In the past the silage was of poor quality, with a dry matter of 20 per cent or less. Now dry matters of between 21 and 37 per cent are achieved, providing maintenance and ½ gallon from silage.

Will it work

Both of the groups described here would follow the basic rules and guidelines for group operation. Provided they follow them properly, a successful operation can be achieved which is readily adjustable to each varying season. They serve to illustrate that group operation of machinery and labour for silage making can enable—

(a) capital outlay on silage equipment to be reduced;
(b) more advanced machines and techniques to be used;
(c) a new technique to be adopted by one member; and
(d) a continuous operation to be carried out by removing the need to reduce the size of the working gang at milking times.

★ ★ ★

Hazards to Children on Farms

Since 1959 no fewer than 241 children under the age of fifteen have been killed on farms in England and Wales. These accidents continue to occur in spite of a vast and continuous amount of publicity in recent years drawing attention to dangers to children on farms, and the introduction of regulations in 1958 prohibiting children under the age of thirteen from riding on, or driving, certain classes of farm machinery.

It should be remembered that young children are naturally inquisitive and adventurous and cannot be expected to foresee danger to the same extent as adults. It is therefore up to everyone to think for them and to see that their lives are not placed in jeopardy. Particular potential danger points are:

Slurry pits, cess pits, ponds, lagoons and wells. These should be either fenced off or covered with covers always being replaced securely in position.

Farm Machinery. Guards—particularly on stationary machines—should be close enough to prevent a small child getting behind and coming into contact with moving machinery.

Chemicals. All chemicals should be kept in proper containers, correctly labelled, out of reach of children and preferably in a locked store. Empty containers should be disposed of and not left lying about in buildings, fields or yards.

Bales. Stacks of hay or straw bales are an undoubted attraction to youngsters since they make ideal playgrounds; what is more natural than den-making amongst the bales? But every year a child is burnt to death through the careless use of matches in such situations. It is a terrifying sight to see a barn on fire; it is heart-rending if a child is in the midst of such an inferno. Children should be kept away from stacks, bales and matches.

Apart from these identifiable dangers, tractor drivers and machine operators should be constantly on the look-out for children playing nearby. Experience has shown time and time again that young children must be kept well away from tractors, trailers and all machinery. It is an offence for anyone to allow a child under the age of thirteen to ride on, or drive machinery or tractors being used in agricultural operations. The fact that safety cabs are now required by law on all new agricultural tractors has not changed the position. It is still illegal for a child to ride on a tractor, even though it is equipped with a safety cab.

We all have an obvious duty to safeguard the lives of young children but we must equally pay due regard to the well-being of the older children who will be the farmers or farmworkers of tomorrow. By setting a good example at all times and following safe practices ourselves, we can help to make them safety-conscious. Time spent now in teaching them correct and safe ways of doing things will go a long way to preventing accidents in the future and thereby help to *Keep Farming Safe.*

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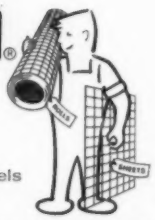

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Group Operations: Sugar Beet Harvesting

Warner K. Hall

In the autumn, on certain types of arable farm, enterprises may conflict in their requirements for labour and machinery. Where the regular labour force is inadequate, this peak demand for men and machines will cause loss of timeliness of operations, with consequent reduction in yields from both current and next season's crops.

In any one autumn a farm might well have to carry out the following operations:

- Potato harvesting and grading
- Ploughing and cultivations
- Harvesting crops such as maize for silage, Brussels sprouts
- Sugar beet harvesting
- Stubble cultivations
- Winter cereal drilling

Machinery

In the past much of the beet has been harvested with single row machines loading into trailers towed along side. These machines are effective and still have a place on some small farms. Their disadvantages are their relatively low rate of work and high labour requirements. With trailers towed alongside, damage to soil structure is likely owing to continual traffic over the surface; this can adversely affect the following crops.

A group could use a tanker harvester which eliminates the need for having a trailer alongside; it is fitted with a hopper holding 30-50 cwt beet. The harvester can be either towed behind a tractor or fitted with a tractor unit, thus becoming self-propelled. For group operation a self propelled unit has the advantage of manoeuvreability and ease of transport, and the specialized frame could be modified for tasks such as spraying at other times of the year. These machines are capable of an overall rate of work of 0·3-0·5 acres per hour and generally require three tractors, two trailers and three men to operate. Alternatively, the group could operate one of the systems which harvest more than one row at a time. These can be 2 or 3-row harvesters or systems which are two or three stage, harvesting 3, 5 or 6 rows at one time. Two-stage harvesters comprise two machines, a topping unit which deposits three rows of tops in a single windrow, and a lifter-loader which lifts and cleans the beet before delivering it directly into an accompanying trailer.

Two-stage machines have a potential overall rate of work of about 0·6 acres per hour and generally require five tractors, three trailers and five men to achieve this output. In the three-stage system there are the three distinct operations of topping, lifting and windrowing, collecting, cleaning and loading the sugar beet into trailers running along side. With all multi-row systems it is important to drill accurately so that the spacing matches up with the harvesting equipment. There is an advantage in having more than one drill in a group so that fields can be drilled quickly, particularly in a spring of variable weather. This system has a possible workrate of 1 acre per hour; to achieve this generally requires four tractors with trailers and seven men.

Multi-row, three stage harvesting system

Sugar beet is clamped in the field or on a suitable loading area. Trailers of the high lift type can enable a group to dispense with a tractor and loader at the clamp thereby reducing the tractor and labour requirement for this part of the operation and also the area required for storage.

Harvesting operations are generally flow processes which require a gang of men. By grouping and operating up-to-date equipment, an effective combined labour force can be assembled. Within a gang, men can be trained to become specialist operators of equipment and are therefore able to achieve optimum output from the machines.

The whole programme of beet growing needs to be closely integrated between the members of the group and all the necessary fertilizer for the crop can, with advantage, be applied as a co-ordinated operation. A modern high output spreader can be used and the group might well take advantage of bulk handling of fertilizer. For beet transport a highly efficient system can be employed, with specialist loader tractors and elevators. Group ownership of lorries for haulage is also a possibility worth some consideration. Alternatively a group should be able to obtain favourable transport rates from haulage contractors.

Examples of group operation

Two examples may be used to illustrate the sharing of sugar beet harvesting machines and labour. The first is of the use of a three-stage 6-row harvesting system on four large arable farms; the second of a self-propelled single-row tanker harvester by three farmers producing a total of 100 acres of beet.

Three-stage 6-row system. Farm A is 700 acres of mixed arable land divided into two sections nine miles apart. This farmer grows 80 acres of beet, and wishes to ensile beet tops and to have more time available for ploughing, winter wheat drilling and carrying out subsoiling on the heavy land. *Farm B* grows 101 acres of beet on 850 acres of mainly arable land. It is fragmented with several miles of roads between fields. There is a need on this farm to drill more winter wheat and plough a larger acreage before Christmas. Brussels sprouts are also to be grown and the casual labour employed for picking could be replaced by the farm's own regular labour. *Farm C* crops 75 acres of beet on a 420-acre mixed arable farm. Sugar beet tops are to be ensiled and more time is required for autumn cultivation and drilling for a larger acreage of winter corn; maize for silage is also to be harvested in the autumn. *Farm D* has 110 acres of beet on 1,058 acres of mixed arable. The farm is divided into three areas approximately equal in size spread over eleven miles. There is a need for considerable ploughing for spring crops to be carried out before Christmas and more attention is to be paid to subsoiling. A large tractor is available for these tasks, but due to the demand on labour in the autumn it is not possible for them to be undertaken.

Because of the need to conserve beet tops for silage the group decides to purchase the necessary equipment and selects the three-stage 6-row system. In addition to the harvesting machines, two high-lift trailers are required so that no extra labour is needed at the clamp to keep it compact and tidy. Drilling is carried out individually but to row widths set by the group. The Figure opposite illustrates the methods of harvesting beet on the farms before and after grouping.

Each farmer supplies one man and a tractor which means that there are four tractor drivers permanently attached to the group, each being responsible for one machine within the system. The three items of harvesting equipment, and also one of the high-lift tipping trailers, are driven by these men. The second high-lift tipping trailer is towed behind one of the group machines to whichever farm it is working on. When the equipment is working on one particular farm it is for the farmer concerned to get the maximum use from the equipment; he is charged for all the time that it is on his farm, except during unsuitable weather conditions or machinery breakdowns. Each farm supplies another three tractor drivers, three tractors and two trailers to the system. One tractor driver operates with the high-lift trailer owned by the group. With this organization, maximum output can be achieved from the system, that is approximately one acre per hour.

The sugar beet factory permit system controls the delivery of beet to the factory and this is not necessarily at the same rate as harvesting. In this group, harvesting is in fortnightly periods on each farm, although if individual members are agreeable and the group has a common permit there is no reason why a whole farm or field may not be harvested before the group's machinery passes on to the next site.

In group operation it is important to make adjustments for labour and tractor use to allow compensation to be paid to the smaller grower for the extra work he puts in for the group. In order that no disharmony should arise between members it is essential that all should understand the financing of the scheme before operating it. The group operation requires four tractor drivers to work for the group for the whole of the season, one man being supplied from each farm. Each group member is charged for the service of this 4-man team but is paid for the services of his man for the whole season

from the group account. By using the 3-stage system each farm will show a reduction in the labour hours used for beet harvesting. This cannot be a cost saving unless that labour is made redundant, (which would not be so in this case) or until the output from other enterprises to which the labour is put is known. This example would show a real saving in labour hours. Regular labour is charged at present at 50p per hour.

All tractors are filled with fuel before leaving the farm on which they have been working; it is essential, therefore, that adjustments are made for this at the end of the season because of the varying amounts used on each farm. In this example 40p per hour is the charge for a tractor (this included depreciation, tax, repairs and maintenance). Fuel is charged at 15p per hour. As group harvesting results in a saving of tractor hours and as each farmer does his own tractor maintenance, group operation results in reduced maintenance costs to each farm.

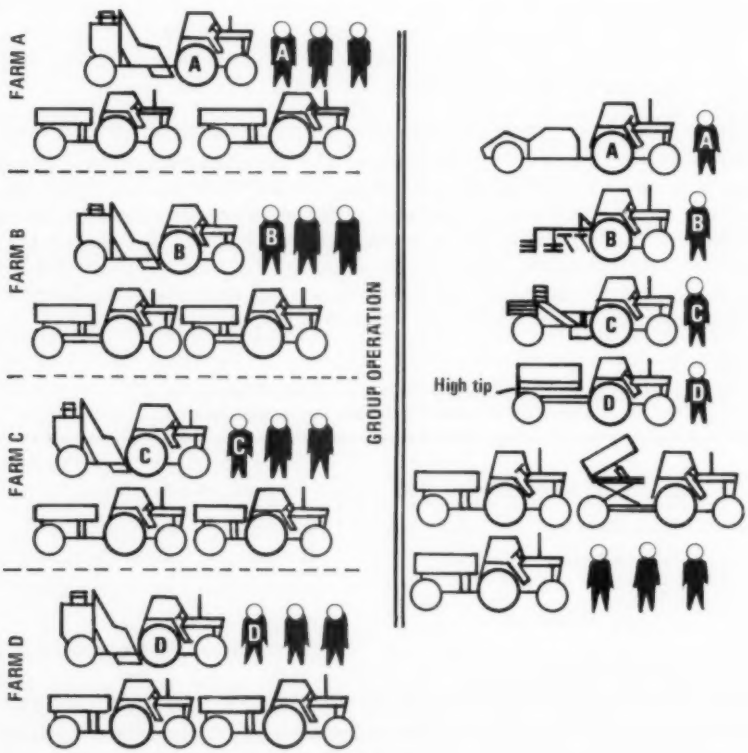


Table 1 illustrates the annual account of the group and the annual accounts of the Farms as individuals; and the savings by group activity in capital cost and labour hours. By group harvesting, farmers A and C show both a cost saving and a reduction in labour use; farms B and D have increased costs but show a considerable saving in regular labour hours which is available for other work on the farm.

All members of the group followed the rules and guidelines discussed in the article 'Group Operation of Machinery and Labour' published in *Agriculture*, August 1972. So far the operation has been very successful and all members are exploring other avenues for group operations.

Table 1

Three-stage 6-row system: Comparison of annual costs between individual and group operation

	Farm A 80 acres beet		Farm B 101 acres beet		Farm C 75 acres beet		Farm D 110 acres beet	
	Individual	Group	Individual	Group	Individual	Group	Individual	Group
	£	£	£	£	£	£	£	£
Machine costs	327	343	327	432	327	321	327	471
Fuel costs	120	84	152	106	113	79	165	116
Tractor maintenance	112	85	142	94	105	83	154	97
Cost of living 4 men and tractor at 90p per hour	—	288	—	364	—	270	—	396
	559	800	621	996	545	753	646	1080
Less amount paid for services of 1 man and 1 tractor	—	329	—	329	—	329	—	329
	559	471	621	667	545	424	646	751
Effects of group operations on costs (£)	−88		+46		−121		+105	
Saving of labour (hours)	194		341		159		404	

Self-propelled single-row tanker system. The three farmers in this group operation grow a total of 100 acres of sugar beet. When harvesting as individuals, two farmers had side delivery single-row harvesters and the third a single-row tanker. Each had their own cleaner loader. As a group they operate a self-propelled single-row harvester and one cleaner loader. Table 2 shows the annual account of the group, the annual accounts of the Farms as individuals and the savings in cost and labour use by group activity.

Table 2

Self-propelled, single-row tanker system: Comparison of annual costs between individual and group operation

	Farm E 35 acres beet		Farm F 25 acres beet		Farm G 40 acres beet	
	Individual	Group	Individual	Group	Individual	Group
	£	£	£	£	£	£
Machine costs	316	294	316	208	506	325
Fuel costs	53	23	38	17	40	27
Tractor maintenance	49	22	35	15	37	25
	418	339	389	240	583	377
Effect of group operation on costs (£)	−79		−149		−206	
Labour use (hours)	350	156	250	110	267	178
Saving in labour (hours)	194		140		89	

All members of the group would show a cost saving by group harvesting and a saving in regular labour hours by making it available for other work.

The sugar beet harvest can be a continuous process with no conflicting demands for men and tractors. Because members cannot all start harvesting at the same time, the programme of operations has to be agreed upon and rotated annually and a group factory permit system could be advantageous.

This group has also operated very successfully by following the basic rules and guidelines for group operation and has considered similar operations for the harvesting of potatoes.

Factors Affecting Sow Fertility

P. Thomas

In late 1969, due to a world cereal shortage, there was a dramatic rise in the cost of pig food. The average production of 15·5 weaners per sow per year proved barely sufficient to maintain profitability and, in particular, the vulnerability of the smaller breeding unit was exposed.

It was apparent that reproductive failure was one of the main causes of this economic loss in the pig industry. The only answer to the problem at that time appeared to be an increase in the breeding efficiency of herds to enable more weaners per sow per year to be produced and reared. A sow should produce two litters of healthy piglets per year and any failure in the sequence of events leading to this achievement is evidence of infertility. The signs vary: failure to return to service after weaning; return to service after mating; abortions; small uneven litters or weakly piglets; the need to cull gilts and sows because of failure to breed.

An examination of the factors involved in this problem showed that it might conveniently be approached from two angles:

More litters per sow per year, i.e., 2-2.4 instead of 1.8;
A reduction in the 15-25 per cent mortality rate of piglets, particularly during the first three days of life.

Achievement of the first objective requires the early re-establishment of pregnancy after lactation, a reduction of the problems of sub-oestrus, anoestrus and return to service after mating, and the practice of an early weaning system. The second objective is discussed within the context of greater supervision and care at farrowing and the segregation and artificial rearing of the problem piglets.

The three most important problems to be examined more closely are:

Failure to return to service after weaning, i.e., sub-oestrus and anoestrus;

Return to service after mating;

Reduction in piglet mortality.

Sub-oestrus and anoestrus

Sub-oestrus relates to an ovary undergoing cyclical activity but without external manifestations of heat, whilst anoestrus denotes complete inactivity of the ovary. Both conditions may occur in thin sows due to a number of causes, such as excess weight loss during lactation, parasitism, discomfort, bullying etc. A sow will not return to service until her bodily condition has been re-established and her other systems are performing normally. She should gain about 30 lb in weight between successive litters. Conversely, if she is too fat because of depressed thyroid activity, oestrus suppression may also occur. Fat, sluggish, inactive sows may be under-sexed. Certain strains of pigs show a lack of libido, a condition which is probably hereditary. In-breeding is known to lead to a reduction in fertility.

The situation often arises in which apparently normal sows fail to exhibit oestrus; although the possibility of an unsuspected pregnancy should be considered, hormonal factors may be involved. Post mortem findings in the intractable cases of anoestrus, associated with hormonal imbalance, are abnormally small inactive ovaries or those showing various types of cysts.

When early weaning practices were first introduced, one of the difficulties encountered was the considerable periods of anoestrus. These all but negated the time saved by the early weaning and in many cases resulted in a high culling rate amongst the sows. Two possible factors are evident here—*nutrition* and *uterine involution*,

Nutrition. Weaning at 4, 7, 10 or even 21 days could mean that the sow has not enjoyed a sufficient length of time on a high plane of nutrition to counterbalance the metabolic upsets of pregnancy, farrowing and the onset and establishment of lactation. This inadequacy of nutritional input will act as a stress suppression of oestrus and not the anticipated stress induction, particularly if she has been receiving only 5lb of a 12 per cent protein feed per day during pregnancy coupled with an enforced 24-hour deprivation of food and water.

Uterine Involution. It takes fourteen days before the uterus returns to its normal size and weight after farrowing and probably a further seven days before it is ready to accept a further pregnancy. Any retention of fluid, afterbirth or purulent material in the uterus can lead to oestrus suppression, but many such cases develop a vaginal discharge which must clear before normal fertility is resumed.

Sows within smell, sound or sight of a boar consistently and noticeably return to oestrus better than those in isolation. Those housed in dark, comfortable quarters with little to disturb them exhibit delays in showing oestrus; conversely, the stress of a journey often seems to induce oestrus, particularly in gilts. Delay has also been noted in periods of hot weather, in association with a depression of thyroid activity which in turn depresses appetite and general activity. In winter, because of the shorter days and colder weather, oestrus periods are shorter and sometimes the signs are not easily detected; so it is feasible that if a group of sows are weaned on Thursday, one or two on heat at the weekend may be missed.

The odd member of a group of newly batch-weaned sows may be subjected to bullying, particularly at feeding times, and unless she is individually fed she may not receive enough food to meet all her requirements. Nutritionally, a number of minerals and vitamins are known or thought to be associated with sub-oestrus or anoestrus, particularly calcium, phosphorus and manganese and vitamins such as A and E.

Return to service after mating

Here we are dealing with a completely different set of circumstances to those associated with sub-oestrus or anoestrus. The ovaries function normally, the oestrus cycle is established, and the sow is mated but returns to heat twenty-one or more days later. Three factors are involved:

The sperms fail to reach the eggs.

All the eggs die within a few hours of fertilization.

All the fertilized eggs develop normally for a period but then die.

Normally sperms reach the eggs in both oviducts within 20-30 minutes of service, by uterine muscular contractions which propel the fluid up the horns and by the motility of the individual sperms. Any uterine condition which prevents or subdues the movement of semen, or any defects in motility or viability of the sperms, could prevent the latter reaching the eggs. Occasionally hormonal imbalance prevents the transfer of eggs or sperm through the oviduct. The commonest cause of permanent sterility due to this condition is blockage of both oviducts by infection, abscessation, or cysts. In gilts, complete absence of both oviducts or other abnormality of the reproductive tract are significant factors.

When all eggs die within a few hours of fertilization, the cause is likely to be inherent genetic defects within the eggs or sperm; this should be relatively a rare phenomenon.

Death of all developing eggs within twelve days of fertilization usually ensures that the sow returns to service within the normal twenty-one day cycle. In this instance, the embryos which are migrating freely within the uterus may be weakly and die, or they may succumb to adverse uterine conditions which either fail to sustain them or prevent the eggs from implanting and developing further. This might occur if the sow develops a fever or a bowel upset with diarrhoea 5-8 days after mating. The more problems of this type are examined, the more it becomes apparent that during the first three weeks after service, i.e., until the developing eggs are properly implanted in the uterine wall, freedom from stress is essential to early piglet survival. Thus bullying, discomfort, poor housing and unnecessary movements of the newly pregnant sow must be reduced to a minimum. Excess feeding during this period is known to have an adverse effect on embryonic survival; and the nutritional factors mentioned earlier may also be implicated.

Death of all embryos after successful implantation is essentially a failure of the sow to maintain the pregnancy. This failure may be caused by infectious, metabolic or any other severe disturbance of her system. Infectious agents are not usually involved in anoestrus but it is thought that certain viruses may be associated with embryonic death and infertility, as may be a bacterial infection introduced at the time of service.

Sow and boar management at service time is critical; it has been known that selective interest by the boar in one or two sows in a group has resulted in failure to serve the others and their subsequent return to oestrus. The boar must be fertile; he must not be over or under-worked, or recovering from an inapparent fever. All these factors can be associated with transient sterility. Double observed or controlled service by different boars has many advantages in the commercial herd.

Reduction in piglet mortality

This is a feasible proposition but supervision at farrowing and artificial rearing of some piglets involve extra labour usage. In the context of this article, diseased piglets are not discussed, but the loss of underweight, weakly, sluggish or splay-leg piglets comes within the broad definition of infertility.

All new born piglets suffer from three disadvantages in relation to their environment and survival. They have:

Low liver sugar reserves;

Little or no body temperature regulating mechanism;

Little or no fat under the skin to act as insulation against environmental temperature changes.

The less active piglets are very susceptible to low or fluctuating temperatures and to starvation. To establish satisfactory conditions for rearing the piglets, a high ambient creep temperature (27°C), gentle air movement and a regular milk supply is needed; any deviation from these leads to retrogressive changes in the piglets, i.e., progressive weakness, collapse and death.

A few years ago it was a waste of time attempting to rear the less viable piglets, but with the success of some very early weaning procedures and the improvements in early creep feeds, rearing of some of these piglets should now be possible. It may be practical to segregate such piglets in a darkened area of the creep on a raised weld mesh floor and rear them artificially.

The supervision of farrowings would save splay-leg piglets, those enveloped in the after-birth, or which need help with their first suckle, or are in danger of being overlain, etc. One authority maintains that 60 per cent of these peri-natal losses are probably unnecessary.

Summary

It is evident from the range of conditions covered by our definition and mentioned in the text that a large number of factors are involved in sow infertility and any problems which arise are often difficult to resolve because of this multiplicity of causes and because one is dealing with a retrospective situation.

A great deal of research is being undertaken to understand some of the problems of porcine reproductive failure. In anticipation of the need for veterinary expertise in this subject, the State Veterinary Service of the Ministry established (in 1969) a team of eight Ministry veterinarians with a special interest and training in this subject. Their purpose is to help disseminate some of the research information and to provide a consultative service to the veterinary profession when these problems arise.

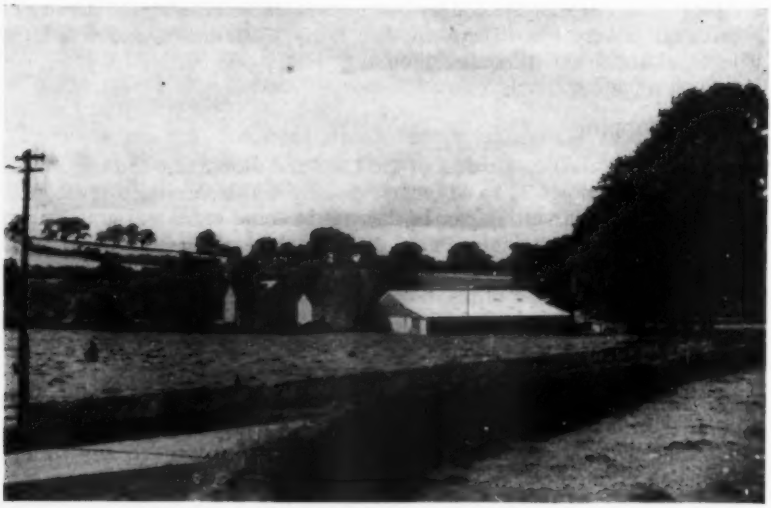
The future profitability of the national pig herd will depend on an improved reproductive efficiency, which in turn requires the resolution of the problems of sub-oestrus or anoestrus, returns to service and piglet mortality.

P. Thomas, B.Sc., M.R.C.V.S., is a Veterinary Investigation Officer at the Veterinary Investigation Centre, Starcross, Devon

Dutch Elm Disease

In a survey last autumn carried out by the Forestry Commission 600,000 trees were found to be severely infected with Dutch Elm Disease out of a total of 18 million elms south of a line from Birmingham to Norwich.

To keep people and authorities in touch with the latest developments the Forestry Commission are now issuing an 'Elm Newsletter' giving a periodic round up of information about the disease. The newsletter is issued by Information Branch, Forestry Commission, 25 Savile Row, London W1X 2AY. (Tel. 01-734 0221).



A 1682 farm house, near Carlisle

12. Lowland Cumberland

G. C. Preston

CUMBERLAND is a large county with great variations in geology and climate resulting in an extreme range of farm systems. It has the highest mountains in England, but also land as flat as Holland just above sea level. The annual rainfall varies from 32 inches at Carlisle (only 26·4 in 1971) to 132 in Borrowdale. The southern part of the county, with parts of Westmorland and Lancashire, comprises the well-known Lake District, flanked by a coastal strip of lowland which is partly industrial and heavily populated in its northern half and southern extremity. Between this region and the county's eastern limit in the Pennines and the northern border with Scotland lies a large tract of productive farmland. It is about this area that the present account is concerned.

Included in the area is the northern part of the Eden Valley with its light fertile land derived from sandstone, becoming almost pure sand near Brampton; to the west is heavier land, including the Solway Plain, which has its drainage problems; in the north, beyond Carlisle, are flat areas of alluvium and peat (some of which is worked commercially for use in horticulture and as stable litter), again with drainage needs, especially where clay is mixed with the peat. In the south of the area, where it merges with hill farming, barley is grown (not ideally!) up to nearly 1,000 ft on the boulder clay soils overlying the limestone which encircles the Lake District. Over the whole

area deciduous trees and hedges are a pleasant feature of the landscape but there are few large areas of cultivated woodland.

Apart from Carlisle, the county town (population 71,000), the density of population is very low. There are five fairly small towns and few large villages, although small hamlets abound.

Arable cropping

The area is in the rain-shadow of the Lakeland mountains and the annual rainfall is in the range 32 to 42 inches, making arable farming a reasonable proposition; but harvesting can be difficult in some years and grassland is liable to poaching in spring and autumn—and even in summer in a year like this! Nearly half the land is in permanent grass, but about a seventh of the total acreage is in arable crops, principally spring barley which has almost completely ousted oats in the last decade. The traditional rotation is corn–roots (mainly swedes)–corn undersown–grass for six or seven years; but this is now much varied and even continuous cereal growing is practised on some farms–with no major problems after as much as seven years. Barley yields average over 30 cwt per acre and oats about the same. The small acreage of winter wheat yields about 35 cwt per acre on average. Sealed moist grain storage and propionic acid have greatly eased the problem of high moisture content in wet harvests as most of the grain is fed to stock.

After a long decline in swede growing, there is a revival of interest in this crop due to mechanical and chemical aids to cultivation and the profitability of winter feeding of sheep. With yields of 35 tons or more per acre, no other crop can give the same dry-matter yield.

Maincrop potatoes are grown on the better soils, with very good yields. Certified seed potatoes are grown on a small scale close to the Pennines, mainly for the higher grades. The National Institute of Agricultural Botany have multiplication and trial plots on one farm in the locality.

Horticulture

The scale of horticulture is small but there is a nucleus of growers with the ability and knowledge to take advantage of any expansion of the market. There are specialists in such crops as mushrooms and flower crops. The largest grower of all-year pot chrysanthemums in the north began as a Land Settlement Association smallholder and now sells to the retail trade in an area of more than 100 miles radius.

The three Land Settlement Association estates near Carlisle have recently been wound up but some of the former members now continue successfully in horticulture and pigs, as independent tenants of the Ministry.

Milk—the main enterprise

Most of the farms in lowland Cumberland produce milk, the sales of which constitute about 70 per cent of the gross output. Although in the last twelve years the number of producers has declined by over 30 per cent the number of cows has increased by more than 5 per cent and milk gallonage by about 50 per cent. The milk goes either to local dairies or, from farm bulk tanks, direct to places as far away as Tyneside and Bradford. The Milk Marketing Board have a modern cheese factory at Aspatria, in the west of the area.

The typical dairy farm is 100 to 150 acres, carrying the farmer and one worker; family workers constitute about half the employed labour force. Cow numbers run from about forty on the traditionally run farms to eighty or more on intensive holdings. There are several herds over 100 cows and a few single units over 200, including a Jersey herd although Channel Islands cattle are otherwise a rarity. Average stocking rate is 1·4 forage acres per livestock unit.

Friesians are the dominant breed but Ayrshires are fairly common, especially in flying herds (of which there are but few) as until recently they could be purchased quite cheaply at Annan and other markets in south-west Scotland.

Although more than half the dairy herds are still kept in tie-up cowsheds, the big breakthrough was the introduction of cow cubicles, which make loose-housing a practical proposition where straw is an expensive commodity. Cubicles are usually associated with self-fed silage, which is still very popular, but there is a minor trend towards mechanically-handled, rationed silage from clamps. Tower silos have become as numerous as in any other part of the country, to the detriment, some would say, of the landscape. As elsewhere, slurry storage is a problem and spreading it a real difficulty on the heavier land in a mild, wet winter.

Other livestock

Dairy heifers are mostly reared for herd replacements within the area but large numbers of beef cattle, store and fat, are sold to go away. Most of the beef calves come from dairy herds, beef breeding stock—mostly single-suckler cows—being mainly confined to the hill districts. Hereford or Charolais bulls are commonly used by the dairy herds.

Most farms carry a ewe flock, or winter hoggs for hill farmers, or fatten lambs–either bred locally or Cheviots and Blackfaces from south Scotland. The ewes are mostly 'Grey-faced'–the progeny of a Blue-faced Leicester tup and a Swaledale ewe. The Blue-faced Leicester is a fairly local breed and a number of small flocks are kept for breeding tups. The Grey-face is hardy and prolific and produces fast-finishing lambs when crossed with a down breed, usually a Suffolk.

Pigs are only of minor importance but there is one large multiple enterprise, associated with a bacon and meat products factory in Carlisle, and a few other fairly large units.

There are many intensive poultry units producing eggs, table chickens and breeding stock; but there are few poultry on general farms.

Markets, education and rural life

The area is served by auction marts at Carlisle, Cockermouth, Wigton, Penrith and Longtown, with seasonal sheep sales at Lazonby (Eden Valley) and Troutbeck (near Penrith).

Agricultural education is based on the Cumberland and Westmorland College of Agriculture and Forestry, Newton Rigg, Penrith, which also runs courses at other centres in the county. Considerable attention is given to agricultural subjects at the local secondary schools.

Community life is strong and many W.I's, Y.F.C's and other social groups flourish. There are two packs of foxhounds in the area and point-to-point races are held annually at Dalston, near Carlisle.

As well as great scenic charm, the area is of much historical interest, dating from Roman times to the testing of 'Blue Streak' rockets near Brampton. The easy access to Scotland enjoyed by present residents was not always a good thing, as the many fortified castles and pele towers built to withstand invaders from north of the border bear witness. Today there are many Scots farming in this part of Cumberland. Cumbrians are very friendly people and offer a warm welcome to peaceful invaders.

Ministry Publications

Since the list published in the August issue of *Agriculture* (p. 367) the following publications have been issued.

MAJOR PUBLICATIONS

BULLETIN

No. 207 Apples (New) £1·25 (by post £1·34½)
(SBN 11 240507 X)

TECHNICAL BULLETIN

No. 23 Avian Embryo Development (New) £2·25 (by post £2·28½)
(SBN 11 240883 4)

FREE ISSUES

ADVISORY LEAFLETS

No. 38 Mosaic and Streak of Tomato (Revised)
No. 115 Slugs and Snails (Revised)
No. 215 Gooseberries (Revised)
No. 318 Cockroaches (Revised)

SHORT TERM LEAFLETS

No. 52 Suggestions for Chemical Weed Control in Vegetables (Revised)
No. 84 Temperature Requirement for the Cultivated Mushroom (Revised)

UN-NUMBERED BOOKLET

Beehealth and Beekeeping in England and Wales (Revised)

UN-NUMBERED LEAFLETS

The Egg Trade and the E.E.C. (New)
Milk and Milk Products and the E.E.C. (New)
E.E.C. Standards for fresh Plums (New)

Priced publications unless otherwise stated are obtainable from Government Bookshops (Addresses on p. 412) or through any bookseller. Single copies of free items are obtainable from the Ministry of Agriculture, Fisheries and Food (Publications), Tolcarne Drive, Pinner, Middlesex HA5 2DT.

Cool Stores for Vegetables

D. Bartlett

WHY should we store farm crops? The answer is that ideally we should not but because of economic and commercial pressures we may have to. The ideal situation is one in which the product can be harvested, marketed and consumed, all within a very short time. Storage, then, is a necessary ill!

Why store?

Perhaps the most significant advantage of being able to hold produce for a short period is that it enables a more effective use of the scarce resources of labour. As wages rise it becomes necessary to avoid long hours of overtime and weekend working which add unacceptably to production costs. By the intelligent use of short-term storage (i.e., 24-48 hours duration) it is possible to have commodities available for delivery when the market demands them and without work having to be done outside normal hours.

Packing staff often prefer to work a 9 a.m. till 3 p.m. day. If storage facilities are available it is possible to hold the produce harvested after 3 p.m. ready for the packers to start work again at 9 a.m. the following morning.

A further benefit which may be derived from storage of produce is that of a marketing aid. The supply of produce is not constant but, to a large extent, determined by weather conditions. Demand is not constant either, and is affected by many factors beyond the producer's control. Some market fluctuations however, are predictable. It is generally recognized, for instance, that there is an increasing demand for produce towards the end of the week. Where this is the case, storage facilities can be used to build up stocks early in the week for delivery at the end. Storage can also allow produce to be marketed on a Monday without the need for Sunday workings.

Another possible use of storage is as a means of 'speculating' with a crop. Sudden changes in demand can have a dramatic effect on the market price of a commodity. Depending on when the produce is put on to the market, large financial gains (or losses) can be made! The use of a store in this way is difficult and a great deal of experience and luck are needed if a good profit is to be made.

A final possible advantage of cooling facilities is that if cold chain marketing becomes important in the field of vegetables, contracts for the supply of produce may call for specific delivery temperatures. Without a cold store these may be difficult to meet.

What can be stored

The post-harvest senescence of most products can be slowed down by cooling. The best storage conditions for a very wide range of products have

been published* but generally, with some exceptions, produce will remain saleable for longest if held at a temperature close to its freezing point. It is not commercially practicable to attempt to store produce at such low temperature and for short-term storage 4°C (40°F) is a reasonable target to aim at.

Types of store

As with all investment, the outlay on a store for vegetables must be viable. In many cases this means that it must be as simple as possible. Old buildings can be modified to make them suitable for the short-term storage of vegetables; this can often prove the cheapest and most economical alternative. Such buildings are often constructed from heavy materials like stone or brick and may require less insulation than newer, lighter structures. Heavy structures will need pre-cooling before use. Where funds are limited, it is probably better to invest in refrigeration machinery rather than extra insulation. This is not to say that no insulation at all is required; on the contrary, a minimum 'u' value of 1·0 W/m².°C (0·2 Btu/ft² °F hr) is recommended. The advantages in going beyond this standard for short-term storage are likely to be minimal.

Where minimum capital input is to be the main consideration it is suggested that 'standard' ceiling-mounted refrigeration equipment be used. When such units are employed, however, it is important that air circulation is directed effectively and it can often be a help to feed the air from floor level to the cooler by means of a simple plywood duct. It is also important when loading the store not to block the discharge of air from the cooler face, and to be sure that air is distributed evenly throughout the store. Produce must be stacked evenly within the chamber. Figure 1. illustrates a method of improving air circulation through batches of produce in order to cool it rapidly.

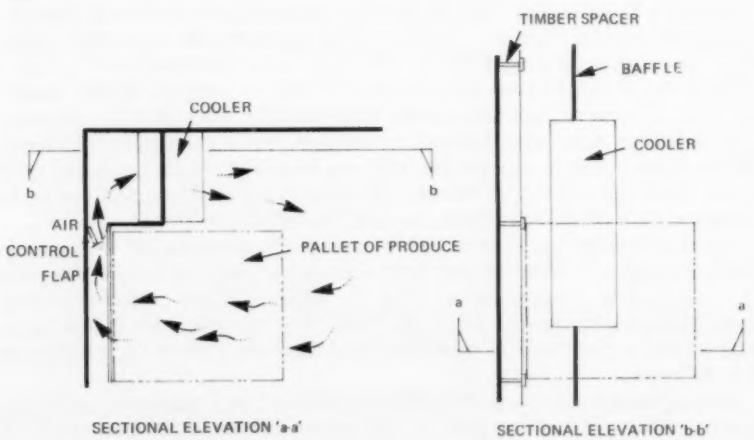


Fig. 1. Method of improving air circulation through batches of produce to cool rapidly (not to scale). Arrows indicate air movement.

*The Commercial Storage of Fruit, Vegetables, Florists and Nursery Stocks. Agricultural Handbook, No. 66, US Department of Agriculture.

*Recommended Conditions for Cold Storage of Perishable Produce. Second Edition. International Institute of Refrigeration.

Refrigeration

It is necessary for 63,300-73,850 kJ (60,000-70,000 Btus) to be removed from each ton of produce cooled. Superficially this appears to present no technical problem. It is a simple matter to select a refrigeration plant capable of removing heat at the required rate. It is not so simple, however, to ensure that the produce which is placed in the store is able to release its heat at the same rate. The importance of air circulation has already been mentioned and to put this in a more precise way, the rate of heat transfer from the produce is dependent on the velocity of the cooling air passing over it; and on the temperature difference between the cooling air and the produce. Practically speaking, the temperature difference between produce and air is limited by the need to avoid freezing damage. Also, if the refrigeration plant is required to produce very cold air, there can be considerable problems as a result of ice forming on the cooling surfaces; furthermore plant is less efficient when removing heat at a lower temperature.

The effect of air speed over the stored material is very largely affected by the method of stacking employed and by the total volume of air which the fans in the store are able to circulate. For efficient cooling it is probably desirable to have a fan capacity of 60-70 times the empty volume of the store per hour. Size of container also has a significant effect on the rate at which heat can be removed. This point is becoming increasingly more significant as the tendency towards mechanical handling methods progresses. Bulk bins and closely stacked pallets present difficult loads to cool effectively. The data on which the table is based is taken from work in the Netherlands* and gives an indication of the rate at which various packages can be cooled.

Table

Cooling time in hours using forced air

Lettuce	Room Cooling	3·5 m/sec.
24 heads (single closed carton)	15 (1·09)	6 (2·73)
24 heads (single open carton)	6·75 (2·42)	2·75 (5·95)
Close stacked pallet	21·25 (0·77)	8·75 (1·93)
Tomatoes		**2 m/sec.**
Pallet loaded with Dutch trays		4 (11·4)

The figures in brackets are calculated maximum cooling rates (Btu/lb.hr). Cooling time is based on reported half cooling times. The time shown is that required to reduce the initial temperature difference between the product and the store air by 80 per cent.

Another modern trend which tends to make cooling difficult is pre-packing. Hot produce which has been pre-packed and then placed in a store will cool very much more slowly than unpacked material. Typically, cooling takes 3-10 times longer for wrapped as opposed to unwrapped material and it has even been suggested that wrapped material may in fact never cool. There can be additional problems in terms of condensation within packs which are completely sealed, but these may be overcome by the use of suitable plastic films which are permeable to water vapour.

Humidity and weight loss

The loss of weight as a result of evaporation of water from produce is always of utmost concern to the producer since it represents a loss of saleable

*Sprenger Instituut Rapport No. 1708.

material. Also, produce when wilted is far less attractive than when fresh and firm. The rate of water loss from the crop while it is in the store is dependent on the vapour pressure difference between the air circulating in the store and the water in the produce. Since the produce is warmer than the air, the vapour transfer gradient is always towards the air. Water loss is also affected by the type of crop. It is well known that lettuce, for example, loses water far more quickly than carrots. This is borne out by the following rates of water loss quoted* for these crops: Lettuce 0·3%/hr.mb.vpd Carrot 0·08%/hr.mb.vpd.

Finally, total water loss from a crop is dependent on the length of time that it is exposed to vapour pressure deficit conditions. The duration of exposure gives the key to the question of weight loss. So long as the storage is really short-term, i.e., 1-2 days, there is no real problem since weight loss from the crop should not be excessive during this period. Storage for longer periods requires more sophisticated facilities.

A factor which is under the control of the designer, is the vapour pressure deficit between crop and air; this means the relative humidity at which the store operates. The cooling plant should be designed so as to maintain as high a relative humidity as possible while at the same time extracting the required amount of heat. Two factors are important: first, the surface area of the coil needs to be adequate; and second, the evaporating temperature must be close to the storing temperature. For most short-term storage work is suggested that the cooling coil be selected to operate at full load with a 4·4-5·5°C (8-10°F) TD.†

Humidifiers

The only really effective way to humidify the atmosphere in a vegetable store is to add steam. Technically it is very difficult to cause liquid water to evaporate unless the relative humidity within the store is fairly low; so the net effect of spray type humidifiers is to wet the produce, and cause considerable icing of the cooling coils. The result of this icing is usually to increase the resistance to air flow through the refrigerating coil and hence to reduce the capacity of the fan to circulate air within the store. This has the effect of accelerating the icing tendency of the cooler. Severe problems can be caused if the cooling coils become solid with ice. If no de-frosting facilities are available it may take several days for this ice to melt, during which time the store is out of action! The tendency, therefore, is to look upon humidifiers as a means of correcting inadequate and inefficient plant. A new system should be designed in the first place to operate without them.

Economics

At the beginning of this article some of the possible benefits of short-term storage were mentioned. It is very difficult to evaluate, in cash terms, savings by way of improved 'labour utilization' and 'market management'. It is possible, however, to give a rough rule-of-thumb guide to the sort of costs one can expect to incur in the construction of stores:

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*Storage Behaviour and Requirements of Crops and their Influence on Storage Parameters. Burton, W. G. Institution of Agricultural Engineers, Spring Meeting 1972.

†Defined temperature difference between the air entering the cooling coil and the refrigerant entering the cooling coil.

	£ per ft³
Cool store plus building	0·5—1·0
Cooling equipment only	0·2—0·4
Insulation only	0·1—0·4

Running costs by comparison with capital depreciation charges for a vegetable store tend to be very small. Probably the most significant proportion of the running costs are the additional handling. Many producers who have invested in storage facilities find a thousand-and-one other uses for them—so there can be hidden benefits!

D. Bartlett, N.D.A., N.D.Ag.Eng., is A.D.A.S. National Storage Engineering Specialist at the East Malling Research Station, Maidstone.

National Mastitis Awareness Scheme

A number of organizations associated with the dairy industry have started a National Mastitis Awareness Scheme to make milk producers aware of the level of mastitis in dairy cattle, and of the losses caused by the condition.

Mastitis is estimated to cost milk producers not less than £20 million a year (or £9 a cow a year) in lost milk yield alone and few, if any, herds are entirely free from the condition. Some producers take suitable steps to keep the incidence of the infection in their animals as low as possible, but effective control needs to be applied much more widely if the present scale of loss is to be substantially reduced. The National Mastitis Awareness Scheme focuses attention on the condition and encourages all milk producers to adopt methods of control such as those set out below as developed by the National Institute for Research in Dairying and the Central Veterinary Laboratory of the Ministry of Agriculture, Fisheries and Food.

1. *Good Stock Management*

   Nothing can replace the well trained careful stockman.

2. *Preventing Infection by Sound Hygienic Routines During Milking*

   Teat-dipping immediately after every milking with a suitable teat dip is *most* important.

3. *Removing Existing Infections by Prompt Treatment of Clinical Cases and of Every Cow at Drying-off*

   Consult your Veterinary Surgeon about what products to use.

4. *Culling Incurable Cows*

   Cull any cows with badly damaged udders or with recurring attacks.

5. *Monitoring the Progress—Cell Counting*

   Have monthly cell-counts of the bulk-milk carried out and discuss their significance with your Veterinary Surgeon.

6. *Efficient Milking*

   Maintain your machine, have it tested regularly and use it properly.

It is emphasized that with one weak link in this chain the effort is wasted. It is important therefore to consult a veterinary surgeon immediately.

in brief

- **Milk from grass**
- **East Anglian forests**
- **Direct drilling**

Milk from grass

NOTWITHSTANDING that grass is acknowledged to be the most important source of ruminant feed in Britain and that long and patient research has placed new and more productive material at the farmer's command, the efficiency of its utilization has in general lagged behind. Particularly is this so in respect of its conservation, whatever the system, both at its nutrient level at cutting and subsequent loss. As Britain readjusts its farming sights to the Common Market an investigation into this area of grassland farming by a workshop team under the aegis of the Agricultural Adjustment Unit of the University of Newcastle upon Tyne deservedly demands close attention. Their report, *Grass Conservation and Dairy Farming**, sees milk from grass as the key to better dairy herd profits as higher cereal prices inevitably tend to whittle down the level of concentrate feeding.

At this crucial time in the re-examination of British agriculture and the need to surmount predictably new competitive hurdles, the maximum utilization of what has, not inappropriately, been called 'green gold' lays an obligation on every grassland farmer, both in his own and the nation's interest. Pastures containing a high proportion of inferior grass species are not difficult to find, whilst the average levels of fertilizer application are low; indeed in too many instances any chemical stimulation is seen to be not unlike Alice in Wonderland jam. It is close on fifteen years since the Caine Committee's report concluded that there was no simple or single key to the better use of grass, but rather considered it to be a matter of higher standards of farm management generally. The Newcastle University report still makes the same point; namely, that the efficient use of grass is complex, involving crop and husbandry aspects and requiring economically sensitive and technically well-informed farm management. 'However', says the workshop group, 'it is open to question whether maximum utilization of grassland and achievement of high nutrient standards of conservation are economical. Depending on farm conditions and the attainable levels of grassland performance, the capital input and managerial expertise required for intensive systems of production and conservation may or may not be worthwhile.' It is the detailed consideration of these basic questions which forms the core of their report, with special emphasis on alternative conservation systems for dairy farming and their evaluation.

Hay, silage and dried grass systems have been examined by the Unit, including analyses of the effects of early and late cutting and the differing levels of conservation efficiency on current dairy herd profits. The results show up the existing advantages of summer milk production from grass, with higher stocking rates and lower winter feed costs; and that herds calving in March have a higher potential gross margin per acre than those calving in September for all systems of conservation at both high and low levels of efficiency. High barley prices will obviously favour the use of conservation systems producing good quality forage, but the report cautions against any high capital investment in silage towers, barn hay drying equipment or grass drying plant. Rather should systems be kept flexible.

*Available from the University, price 50p (by post 55p).

East Anglian forests

NOWHERE is the forester's skill more in evidence today than in areas of East Anglia which formerly were largely arid wasteland. For centuries these supported little but wild life, and the most remarkable are the sandy heaths of the Breckland on the Norfolk-Suffolk border. Where once much was barren, new forests, covering over 65,000 acres and started by the Forestry Commission in the 1920s, are now producing maturing timber, mainly Scots pine, some Corsican pine and, where possible, belts of broadleaved trees. Identified as Thetford Forest, some 25 miles to the south-west of Norwich, and the smaller, outlying forests of Lynn and Wensum in the north of the county and Aldewood between Aldeburgh and Woodbridge in Suffolk, these plantations are described in a new Forestry Commission publication, *East Anglian Forests**. The wealth of detail covers not only their purely sylvicutural value, but embraces the wider context of their recreational amenity, their animal and plant life and the early geophysical and settlement history of the East Anglian region.

Described is the evolution of Thetford Forest, the largest in England (80 square miles) out of the agricultural poverty which marked vast stretches of the Breckland that had deteriorated into grass, heath and heather. It is of interest to recall that many farmers in this area after the First World War had recourse only to rabbit farming, the pelts going to the fur felt factories in nearby Brandon and the carcases to London. The picture today is very different, with Breckland agriculture enjoying a fair share of prosperous East Anglian farming. (Norfolk is said to possess more tractors per thousand acres than any other county in the United Kingdom). Its light land, under modern technical management and with the breeding of new strains of corn, has come into its own. Indeed, says Mr. George Backhouse in his chapter on Thetford Forest, 'but for the existence of the forest today, the whole area would be under agricultural crops. This is a sobering thought for all who, quite understandably, regret the disappearance of so much of the old brecks or heaths'.

This is, or was, Borrow's country where 'there's the wind on the heath, brother'. Assuredly he would not recognize the scene today. To the naturalist, nature-lover and conservationist, by the facilities which the Forestry Commission has made available to them, these new forests offer substantial new resources, holding for discovery the rarities of plant and animal life for which the brecks have long been famous.

Direct drilling

ANYTHING that will save time commands farmers' instant attention. Direct drilling to get rid of the chores of cultivation is therefore highly attractive. Why, asks its advocates, laboriously bury weeds and their seed to provide a subsequent competitive 'crop' when herbicides will kill them *in situ*? Why disperse and dilute humus from the top layer of soil? In short, why plod in tradition for tradition's sake? These are pertinent questions to which Boxworth E.H.F. has been giving its attention and now comments upon in its annual report.

A certain degree of success with direct drilling, even widely adopted in some areas especially for seeding or reseeding grassland and for green fodder crops, automatically promotes interest. On the heavy soils of the chief cereal growing areas, however, its success has been more limited—offset by compaction, couch and increased fixed costs. Tested over several years at Boxworth, yields of winter wheat never reached the levels obtained by the more traditional methods. Nevertheless, experience has indicated that provided soil conditions are good in depth, e.g., after a previous winter crop which leaves the soil more friable, some means of *minimal* cultivation could be feasible in some years to create a seedbed from the stubble merely by a light discing or tined cultivation. The initial cultivations for a winter crop should obviously follow quickly upon the harvest to give as much time as possible for natural weathering before the drill goes in, for much depends on the right conditions in this intervening period.

*Obtainable from H.M. Stationery Office, price 50p (56½p by post) or through any bookseller.

Books

Fertilizing for Maximum Yield. G. W. Cooke. Crosby Lockwood and Son, 1972. £2·50.

Recent advances in agricultural science, such as the breeding of improved varieties, better weed, disease and pest control, and the development of new farming systems, have raised the potential yield of many important crops. The purpose of Dr. Cooke's latest book is to show how these new advances can be consolidated by exploiting the interactions which exist between increased fertilization and the control of the other factors which affect plant growth.

This volume, of some 300 pages, contains over 60 tables, and is directed mainly at British farmers, advisers and students. However, as the principles of plant nutrition which are discussed apply to all crops, the book will also be of value to agriculturists in other parts of the world.

The introductory chapter outlines the progress of fertilizer usage in Britain and leads to an up to date account of organic and inorganic fertilizers, including micronutrients. This is followed by a major section devoted to the planning of fertilizing for maximum yield. Chapters describing fertilizer responses, plant nutrients cycles and the practical value of soil and plant analyses are included. Advice is also offered on the fertilizing of arable crops and grasslands in Britain, while overseas students are catered for in the final chapter which deals with the principles of profitable manuring of some crops grown in warm climates.

In addition, there is a bibliography containing over 100 well chosen references which provide the reader with the opportunity of exploring further sources of information.

Dr. Cooke is to be congratulated for assembling such a wealth of scientific knowledge in one volume and for achieving his objective through an easily read text. This book can be thoroughly recommended to all agriculturists with an interest in modern concepts of crop fertilization.

D.H.

The Remoter Rural Areas of Britain. Edited by J. Ashton and W. Harwood Long. Oliver and Boyd, 1972. *£2·50.*

This book has been published for The Agricultural Adjustment Unit, which was established at the University of Newcastle-upon-Tyne in 1966 with the help of a grant from the W. K. Kellogg Foundation. The Unit forms part of the Department of Agricultural Economics within the Faculty of Agriculture, and its Director is Professor J. Ashton who is the joint editor of this book. The purpose of the Unit is educational, in the widest sense, and is concerned with the means by which the farming industry may adapt itself to changing conditions and to the many pressures upon the countryside. It seeks to bring about a greater awareness, not only of the economic factors but also of the institutional and social problems which inevitably arise in a period of rapid change.

The book, which is the sixth of a series, contains a set of thirteen symposium papers contributed by specialists in a range of disciplines, including economics, sociology, planning, agriculture and forestry. The papers analyse the nature of the changes that are taking place and consider what adjustments are necessary. The characteristics of the remoter areas are described and their present economic, social and institutional framework discussed. Various attempts to solve these problems on a regional basis in Britain and Europe are outlined. Policy objectives for the remoter areas are also discussed.

The inclusion of basic land utilization statistics assist with the appraisal of the basic economic and social framework. The past policy of the Forestry Commission is explained and a sound case made for the retention and possible expansion of forestry in the remoter rural areas, be it in private or Commission hands. Agriculture and Forestry are regarded as economic and social partners, and the need for amenity and recreational facilities are also considered.

It is pointed out that the machinery of government which exists to enable the general planning in the remoter areas to be co-ordinated rests in a number of bodies: Planning Authorities; the Development Board; the Countryside Commission; Tourist Boards; Forestry Commission and others. This results, perhaps, in too many interests with overlapping responsibilities. There is a warning, however, that a unitary authority often takes an unconscionable time to produce effective plans and may be overtaken by the march of events.

Any criticism of the symposium papers and the editors' summary is that too much

emphasis has been placed on past events and historical background, although such a record is of value. Some consideration of future hypotheses would have been welcomed. Even greater emphasis should have been placed on the essential need to conserve the remote rural environment whilst facilitating the balance of interests between farmers, foresters and the recreational needs of the urban population.

The bibliography included by each contributor is comprehensive and is one of the excellent features of the book. *H.J.H.*

Soil Micro-Organisms. T. R. G. GRAY AND S. T. WILLIAMS. Oliver and Boyd, 1971. £3.

This is a most readable and stimulating book, bringing within the compass of 196 pages a wealth of recent studies on diverse aspects of soil micro-organisms. The material is logically developed.

An initial account of the soil population deals with physiological rather than taxonomic features of the micro-organisms but contains condensed and well arranged tables giving the essential characters separating the groups. A short, clearly composed section deals with the characteristics and physical structure of soils as they relate to and affect soil micro-organisms. Selected methods of detecting and isolating organisms are critically and succinctly reviewed and a thoughtful discussion deals with the estimation of biomass. The decomposition of organic matter and of organic chemicals comprises two chapters which are followed by those dealing with the effects of living plants on soil micro-organisms and of these on plant growth. Autotrophic micro-organisms receive a condensed but informative treatment and the book concludes with two chapters dealing in turn with the interactions between soil micro-organisms and with these in relation to the soil-plant ecosystems.

There are 579 well selected and pertinent references. The book is well illustrated by meaningful tables and graphs, and contains eleven plates of thirty-nine figures. Fifteen of these demonstrate the application of the scanning electron microscope to the study of soil micro-organisms 'in situ' and two demonstrate the excellence of fluorescene techniques.

It is refreshing to read a book on soil micro-organisms with a clearly biochemical and physiological bias in which the authors highlight the many gaps in our knowledge of essential processes taking place in soil. The student and graduate will find much to stimulate their curiosity which, one hopes, will encourage the brave to attempt to solve the wealth of problems indicated.

The text is refreshingly free from proof reading errors and the print used is excellent.

C.G.C.C.

Environmental Pollution by Chemicals. COLIN WALKER. Hutchinson Educational, 1971. *£1·05.*

There is a growing concern about the environment and the effects on it of modern technology, both directly and through the disposal of effluents. This book gives an account of some of the chemical pollutants using well documented examples to illustrate important principles.

The possible effects of chemical pollution on man gives rise to a good deal of public concern and the author deals with the interaction of foreign compounds with living organisms. Problems of distribution, metabolism, excretion and mode of action of pollutants are dealt with in relation to persistence and accumulation along food chains. The book covers four main groups; gases, heavy metals, insecticides and fungicides and detergents, including aromatic hydrocarbons and polychlorinated biphenyls (PCBs), which may have contributed to the deaths of sea birds recently on the north-west coast of England.

Agriculture is often accused of polluting the environment. This book shows that although there are dangers from the indiscriminate use of chemicals in farming there are greater dangers of pollution from other sources. Residues in rain water and run-off from agricultural land contribute to the pollution of rivers by organochlorine pesticides but industrial effluents appear to have been more important factors in Britain. The final chapter discusses the risks and control of pollution and the many factors involved. Pollution concerns scientists from many disciplines; politicians, administrators, journalists and indeed everyone. There is certainly no room for complacency and although a great deal of progress has been made much remains to be done; undoubtedly many problems could be solved if sufficient money was made available.

A better understanding of the use of chemicals and their effects is needed and this book makes a valuable contribution in its review of some aspects of the subject. There is a useful glossary of terms for the non-technical reader and a selection of further reading.

E.S.C.

The Domesday Geography of Eastern England. 3rd Edition. H. C. DARBY. Cambridge University Press, 1971. £10.

The fact that this first volume, originally published in 1952, is now in its third edition and considerably revised in the light of recent research and new place-name identification is evidence enough of the acknowledged value of a scholastic *tour-de-force*. Of the seven volumes that make up the complete work under the guiding hand of Professor Darby, this part is particularly noteworthy for its introductory chapter on the making of the Domesday Book and the insight which it gives into the difficulties of analysis and interpretation of this vast eleventh century inventory which underlie the present work. What has been done is tantamount to unravelling a rich tapestry and re-weaving it for a clearer modern understanding of the English countryside suddenly brought under the rule of the Norman invader.

Lincolnshire, Norfolk, Suffolk, Essex, Cambridgeshire and Huntingdonshire are the counties covered by this volume, comprising areas that are by no means identical with those of Domesday times; and out of the same mists which the author has sought so strenuously to penetrate, the identification of place-names comes as a further revelation. To turn the pages of this book is to open a window on the life and circumstances of agrarian communities living so close to the soil as to be identified with it. Though earlier researchers have tilled the same field and pronounced theories that have both helped and hindered, it can be said without exaggeration or fulsome praise that this historical geography is without a peer.

S.R.O'H.

Agricultural Chemicals Approval Scheme

There are no Additions or Amendments to the 1972 List of Approved Products for Farmers and Growers this month.

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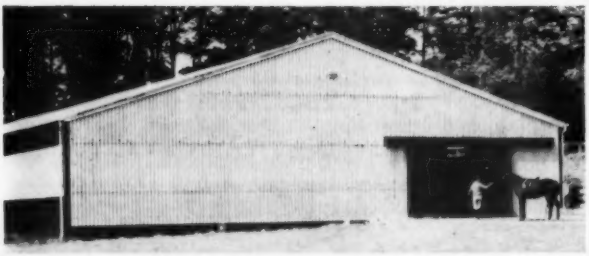

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Second Edition—1971

FERTILIZER TECHNOLOGY & USE

Developments in fertilizer technology and use during the past ten years have prompted the Soil Science Society of America to revise the first edition of FERTILIZER TECHNOLOGY & USE.

The second edition of FERTILIZER TECHNOLOGY & USE is now available and contains the proceedings of the "Symposium on Fertilizer Technology, and Use" held in Chicago on February 11-12, 1971. Edited by R. A. Olson, T. J. Army, J. J. Hanway and V. J. Kilmer, the book contains discussions of the latest information concerning fertilizer production, marketing, and use, and the effects of fertilizers upon soils and the human environment.

This handbook and reference guide would be of interest to industrial agronomists, university and agricultural instructors, farm supply dealers, environmentalists, and of special interest to fertilizer researchers and dealers.

Published by the Soil Science Society of America, December 1971, 611 pages. Illus. Hardbound. $8 (members), $10 (nonmembers) per copy.

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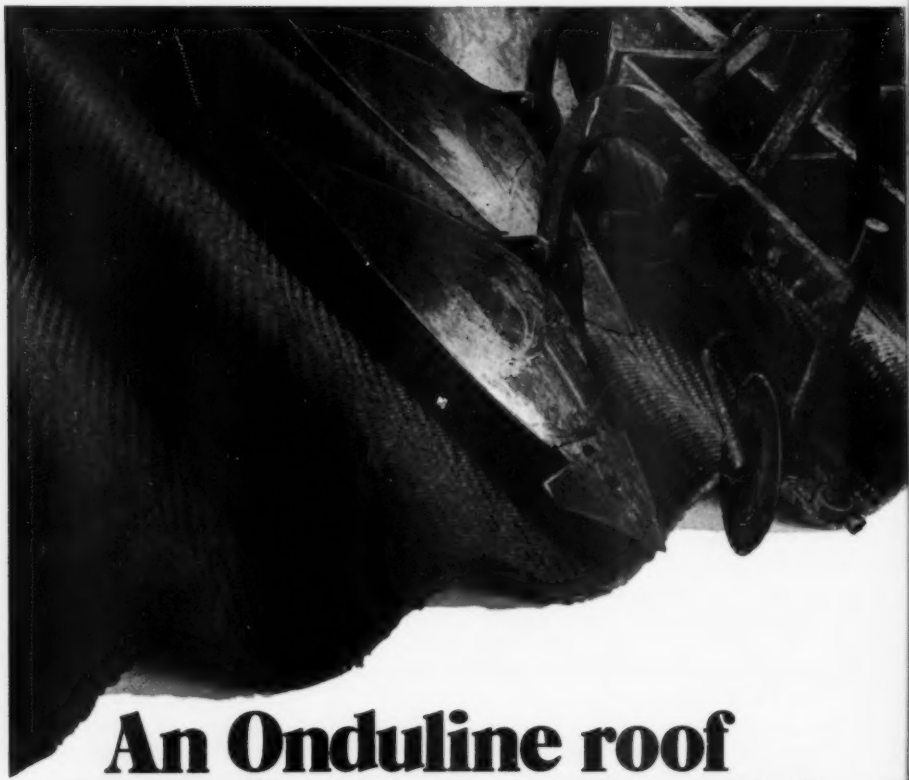

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